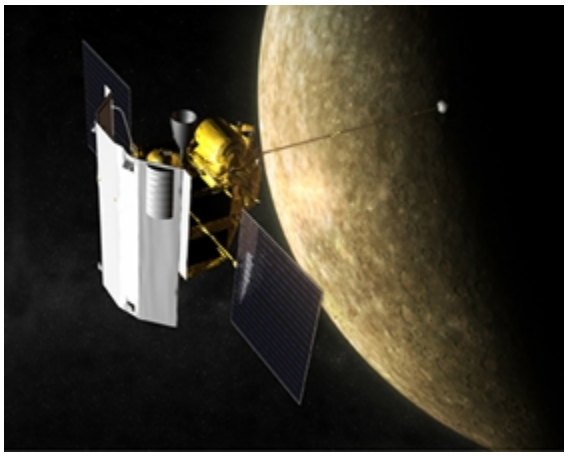


MESSENGER

Mercury Surface, Space Environment, Geochemistry, and Ranging

Welcome to the Solar System

Presentation by

Sharon Freeburn

Space Grant Education & Enterprise Institute

On August 3, 2004, NASA launched the MESSENGER spacecraft to Mercury, the second mission to the planet. MESSENGER will enter orbit in 2011 and begin a full year of observations. MESSENGER is destined to change our view of Mercury—and how our Solar System was born.

Mercury: The Key to Terrestrial Planet Evolution

Six Key Questions

1: Why is Mercury so dense?

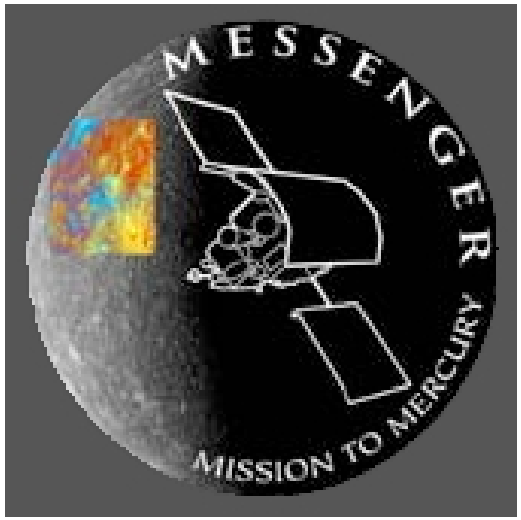
2: What is the geologic history of Mercury?

3: What is the nature of Mercury's magnetic field?

4: What is the structure of Mercury's core?

5: What are the unusual materials at Mercury's poles?

6: What volatiles are important at Mercury?



MESSENGER Education

- Focus not only on what science is taught, also how science is taught
- Encourage students to ask questions – inquiry based, process driven approach

Modules cover K-12

How to Get Materials

http://messenger.jhuapl.edu/

www.sharonfreeburn.com/messenger.html

Theme 1: Comparative Planetology

What we know & don't know about the family of planets

- ⊡ Voyage
- ⊡ The Voyage Continues
- ⊡ Ice in the Solar System

Theme 2: The Solar System through History

How we have come to know about the Solar System

- ⊡ Stories Across Cultures

Theme 3: Framing Pathways to the Scientific Process in Action

Exploration of Scientific Process

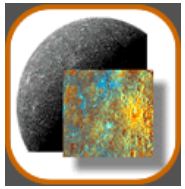
Solving engineering & design problems

Exploring phenomenon of nature

- ⊡ Staying Cool
- ⊡ Spacecraft Design

Which theme do you think you will find most useful?

Introduction to the Voyage Education

Grades	LESSONS		
K-2	Making Models to Understand our Home	A View of Home from the Front Door and from Space	Taking a Voyage Away from Home
3-4	Modeling Patterns and Cycles in Our Lives	Designing a Scale Model of the Solar System	Voyage Through the Solar System
5-8	Our Solar System	Voyage of Discovery	How Far is Far?
9-12	A Scale Model Solar System	The Voyage Scale Model Solar System	

Our Solar System 5-8

What Does a Lesson Include?

- Lesson Overview
- Lesson Duration
- National Science Standards
- Essential Questions
- Concepts
- Objectives
- Science Overview
- Warm-up &
- Pre-Assessment

Solar System Catalog

- Materials
- Lesson
- Teaching Tip
- Student Worksheet
- Reflection & Discussion Adaptation
- Assessment Rubric
- Transfer of Knowledge
- Extensions
- Resources
- Student Worksheet

Create a Travel Brochure

The Power of Models
by Dr. Jeff Goldstein

Greatest Mistakes:

1. Teach the jargon, and encourage rote memorization of the concepts
2. Teach the book of knowledge in isolation from the process of scientific inquiry, or with process itself defined as a recipe to memorize
3. Deny the student ownership in the process, and his/her ability to create new through that process

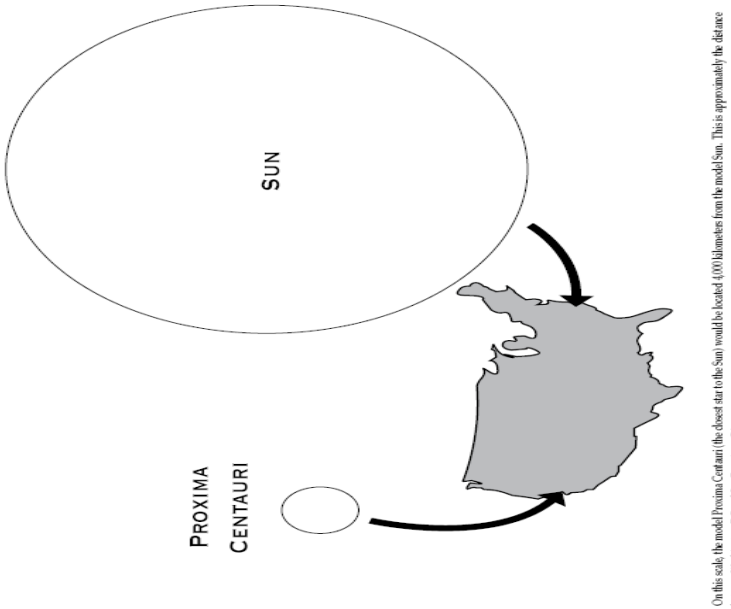
Science Models

1. Physical
2. Conceptual
3. Numerical

The Sun is located 150,000,000 km (93,000,000 miles) from Earth. Travel from Earth to the Sun at the speed of a commercial jet—at 600 mph (1,000 km per hr)—it would take 17 years!

Model of the Solar System 3-8

	Model Distances Chart		
	Paces (or meters) between models	Total paces (in meters) from model Sun to each model planet	Distance from the Sun to each planet in meters
Sun to Mercury	6 meters	6 meters	60,000,000,000
Mercury to Venus	5 meters	11 meters	110,000,000,000
Venus to Earth	4 meters	15 meters	150,000,000,000
Earth to Mars	8 meters	23 meters	230,000,000,000
Mars to Jupiter	55 meters	78 meters	780,000,000,000
Jupiter to Saturn	65 meters	143 meters	1,430,000,000,000
Saturn to Uranus	144 meters	287 meters	2,870,000,000,000
Uranus to Neptune	163 meters	450 meters	4,500,000,000,000
Neptune to Pluto	142 meters	592 meters	5,920,000,000,000

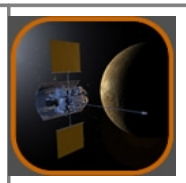


Suggested foods for Model Planet Cards*

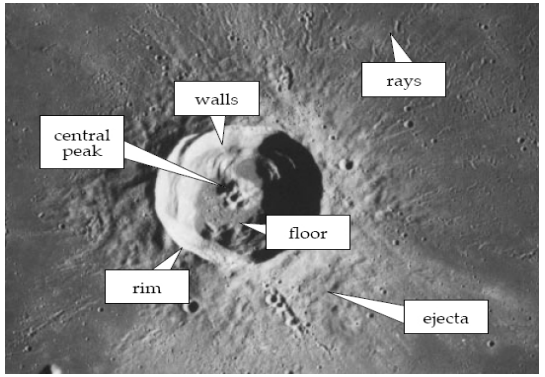
Mercury	Poppy seed
Venus	Mustard seed
Earth	Mustard seed
Mars	Poppy seed
Jupiter	Gumball
Saturn	Spherical cereal (e.g. Kix)
Uranus	Soybean
Neptune	Soybean
Pluto	Small fleck of ground pepper

* These foods are only suggestions. You can use any spherical foods that approximate the size of the model planets.

The Voyage Continues

Grades	LESSONS		
5-8	Going through a Phase	Round and Round We Go—Exploring Orbits in the Solar System	Where to Look for Life?
	Is There Anyone Out There?	Comets: Bringers of Life?	Impact Craters: A Look at the Past

Impact Craters 5-8



Ice in the Solar System

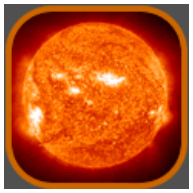
Grades Pre- K-5	**LESSONS**		
	Inquiry Icebreaker: An Ice Experience		
	Lesson 1:Melting and Freezing	Lesson 2:Ice Has Structure	Lesson 3:Ice Is a Mineral
	Lesson 4:Ice Floats	Lesson 5:Ice Flows	Lesson 6:Snow is Ice
	Lesson 7:Layers of Ice	Lesson 8:Life in Icy Places	Lesson 9:Ice in Space
	Lesson 10:Comets	Lesson 11:Investigating Icy Worlds	Lesson 12:Ice in the Shadows

Ice Has a Structure K-5

The Solar System through History

TBD

Staying Cool

	How can we study Mercury?	Are there any problems we might face?	Are there ways to solve these problems?	Design Challenges
Grades	**LESSONS**			
Pre-K-4	Sensing Energy		Cooler in the Shadows	Design Challenge: What will keep my lunchbox cool? Design Challenge: Keep it Cool! How do you keep thing from getting too hot?
5-8	Herschel Experiment	Snow Goggles	My Angle on Cooling. Effects of Distance and Inclination	Design Challenge: How to keep gelatin from melting
9-12	Star Power! Discovering the Power of Sunlight	Dangers of Radiation Exposure	Cooling with Sunshades	Design Challenge: How to keep items cool in boiling water

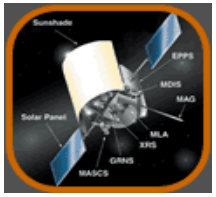
Sensing Energy preK-4

WORKSHEET 1

Record observations of UV beads in film canisters.

CANISTER	START COLOR	END COLOR
Canister 1. (control) on the ground with nothing over it	_____	_____
Canister 2. covered with a white piece of cloth	_____	_____
Canister 3. covered with a black piece of cloth	_____	_____
Canister 4. covered with sunglasses	_____	_____
Canister 5. covered with a baseball cap	_____	_____
Canister 6. filled with water	_____	_____
Canister 7. covered with plastic wrap	_____	_____
Canister 8. covered with plastic wrap and a coat of sunscreen (spf 5 or 8)	_____	_____
Canister 9. covered with plastic wrap and a coat of sunscreen (spf 30)	_____	_____

Spacecraft Design

	How do you design/build a spacecraft to go to another planet?	How do you get there?	What do you do when you get there?
Grades	LESSONS		
Pre-K-4	TBD	TBD	TBD
5-8	Mission: Possible – How Can We Plan an Exploration of Another Planet?	TBD	TBD
9-12	TBD	TBD	TBD

How Can We Plan an Exploration of Another Planet? 5-8